

Compact flow rate sensor Separated display

RAPIFLOW® FSM2-D

■ Flow rate sensor



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Compact flow rate sensor (RAPIFLOW)
FSM2-D Series
 Separated display



Refer to the CKD website for detailed compatible model Nos.

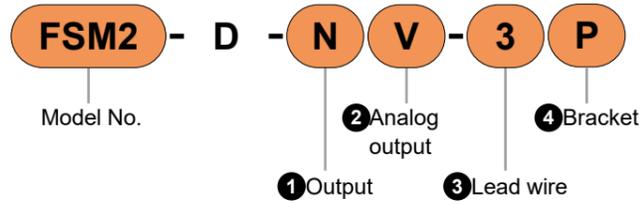
FSM2-D Series
 Specifications

Specifications

Item		Separated display FSM2-D-[1][2]-[3][4]	
Settable flow rate range *1	mL	5, 10, 50, 100, 500, 1000	
	L	2, 4, 5, 10, 12, 20, 25, 32, 50, 100, 200, 500, 1000	
	m ³	1.5	
Operating ambient temperature / humidity		0 to 50 °C	
Indicator type		4 digit + 4 digit 2 color LCD	
Input voltage		1 to 5 V	
Output	Switch Output	①	N Output 2 points (NPN open collector output, 50 mA or less, voltage drop 2.4 V or less) P Output 2 points (PNP open collector output, 50 mA or less, voltage drop 2.4 V or less)
	Analog Output	②	V 1 to 5 V voltage output 1 point (connecting load impedance 50 kΩ and over) *5 A 4 to 20 mA current output 1 point (connecting load impedance 0 to 300 Ω)
Power supply voltage		②	V 12 to 24 VDC (10.8 to 26.4V) A 24 VDC (21.6 to 26.4V)
Current consumption		*2	40 mA or less (when 24 VDC is connected, and no load is connected)
Lead wire		ø3.7, AWG26 or equivalent x 5-conductor (connector), insulator O.D. 1.0	
Functions		Flow rate display, flow rate display peak hold, switch output, analog output	
Degree of Protection		IEC standards IP40 or equivalent	
Protection circuit		*3	Power reverse connection protection
EMC Directive		EN55011, EN61000-6-2, EN61000-4-2/3/4/6/8	
Accessory		1 connector for sensors (e-con), compatible cable AWG 24 to 26, insulated outside diameter 1.0 to 1.2	
Weight (main body only)		Approx. 40 g	

*1: FSM3 The flow rate range, flow direction and gas type are automatically recognized only when the bar display is connected. (Default state)
 The FSM-H Series, FSM-V Series and WFK3000 Series flow rate ranges are supported, but automatic recognition is not. Always set the product's flow rate range, flow direction and gas before use. The connectable flow rate ranges are shown in "Display by flow rate range" below. The "Gas Type Setting" function of this product is not a "Gas Type Switching" function that switches the sensor characteristics to match the gas type. If a "Gas-type Switching" function is required, use the LCD display-type.
 When the sensor section is changed, the previous flow rate range settings, etc., will still be recorded. Always reset the settings before using.
 *2: Current for when 24 VDC is connected, and no load is connected. Please note that the current consumption changes depending on the load connection status.
 *3: This product's protection circuit is effective only for specific misconnections and load short-circuits. It does not provide protection for all misconnections.
 *4: When connecting to the FSM-V Series or WFK3000 Series, the lead wire size is different so a separate compatible sensor connector (e-con) will be required. Contact your nearest CKD Sales or dealer. The attached sensor connector (e-con) can be used with the FSM2 Series, FSM3 Series and FSM-H Series.
 *5: The output impedance of the analog output section is approx. 1 kΩ. If the impedance of the connecting load is small, output and error increase. Check error with the impedance of the connecting load before using.
 *6: FSM3 bar display When connected to oxygen specifications, the gas display will be "Ai" (air, N2), but this does not constitute a problem for use.

Model No. Notation Method



Note: The corresponding sensor is the voltage output (1-5 V)-type. If the current output-type or other voltage output-type is connected, it will not operate properly. When using FSM3, Use the bar display voltage output.

① Output

Code	Description
N	Switch output (NPN) 2 points, analog output 1 point
P	Switch output (PNP) 2 points, analog output 1 point

② Analog output

Code	Description
V	Voltage output (1 to 5 V)
A	Current output (4 to 20 mA)

③ Lead wire

Code	Description
Blank	None
1	1 m
3	3 m

④ Bracket

Code	Description
Blank	None
P	Panel mounting kit

Clean-room specifications (Catalog No. CB-033SA)

FSM2-D - P70

Model No. Notation for Options

- Sensor connection connector (e-con) 5 sets

FSM2-EC

- 5-conductor lead wire 1 m

FSM3-A

- 5-conductor lead wire 3 m

FSM3-B

- Panel mounting kit

FSM3-K

Display by flow rate range

Flow rate display	Indicator range	Uni-direction	0 to 500 mL/min	0 to 1000 mL/min	0 to 2.00 L/min	0 to 4.00 L/min	0 to 5.00 L/min	0 to 10.00 L/min	0 to 2.0 L/min	0 to 20.0 L/min	0 to 25.0 L/min	0 to 32.0 L/min	0 to 50.0 L/min	0 to 100.0 L/min	0 to 200 L/min	0 to 500 L/min	0 to 1000 L/min	0 to 1.50 m ³ /min	0 to 5.00 mL/min	0 to 10.00 mL/min	0 to 50.0 mL/min	0 to 100.0 mL/min
		Bi-direction	-500 to 500 mL/min	-1000 to 1000 mL/min	-2.00 to 2.00 L/min	-	-5.00 to 5.00 L/min	-10.00 to 10.00 L/min	-	-20.0 to 20.0 L/min	-	-	-50.0 to 50.0 L/min	-100.0 to 100.0 L/min	-200 to 200 L/min	-500 to 500 L/min	-1000 to 1000 L/min	-1.50 to 1.50 m ³ /min	-5.00 to 5.00 mL/min	-10.00 to 10.00 mL/min	-50.0 to 50.0 mL/min	-100.0 to 100.0 mL/min
Indicator resolution			1 mL/min		0.01 L/min			0.1 L/min			1 L/min			0.01 m ³ /min	0.01 mL/min	0.1 mL/min						
Indicator range			9999999 mL		99999.99 L			999999.9 L			9999999 L			9999.99 m ³	99999.99 mL	999999.9 mL						
Indicator resolution			1 mL		0.01 L			0.1 L			1 L			0.01 m ³	0.01 mL	0.1 mL						
Integrating functions*2			5 mL	10 mL	0.02 L	0.04 L	0.05 L	0.1 L	0.12 L	0.2 L	0.25 L	0.32 L	0.5 L	1 L	2 L	5 L	10 L	15 L	0.05 mL	0.1 mL	0.5 mL	1 mL

*The corresponding sensor is the voltage output (1-5 V) type. If the current output-type or other voltage output-type is connected, it will not operate properly.

*1: The flow rate display is rounded off at approximately ±1% or less (forced zero).
 *2: The integrating flow is a calculated (reference) value. It is reset when the power is turned OFF.

Flow rate sensor

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (air)

Compact flow sensor (liquid)

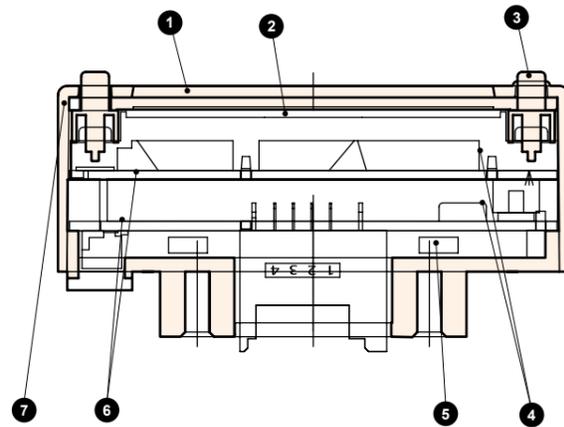
Compact flow sensor (liquid)

Water Manifold Unit

Water Manifold Unit

Internal Structure Diagram / Material

●FSM2-D



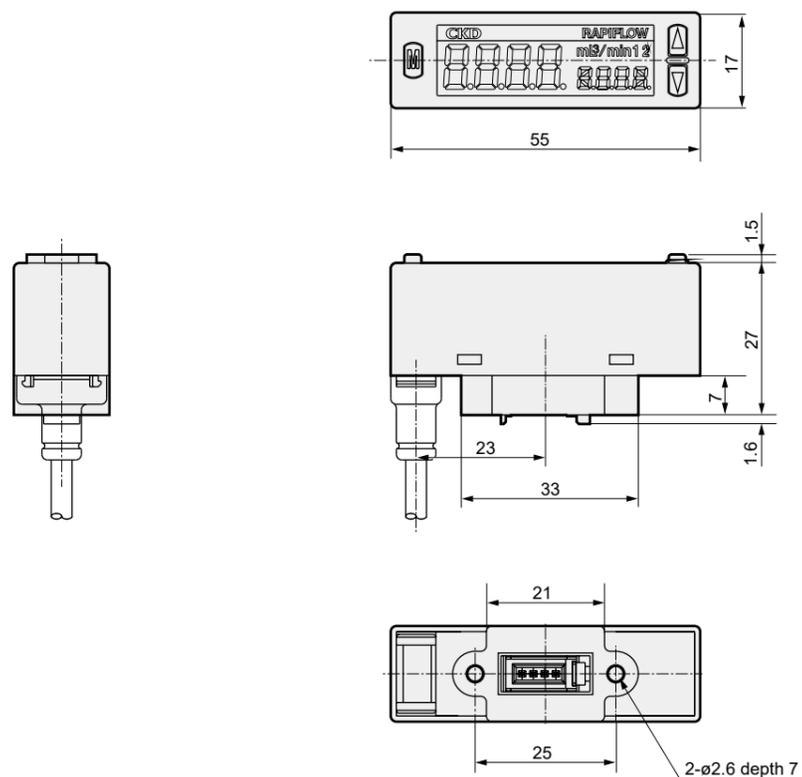
Do not disassemble

Note: Parts materials are subject to change without prior notice.

Part No.	Part name	Material
1	Liquid crystal cover	Acrylic resin
2	Liquid crystal	-
3	Switch	Ethylene/propylene rubber
4	Base spacer	Polycarbonate resin
5	Back surface cover	Polyamide Resin
6	Electronic circuit board	-
7	Case	ABS resin

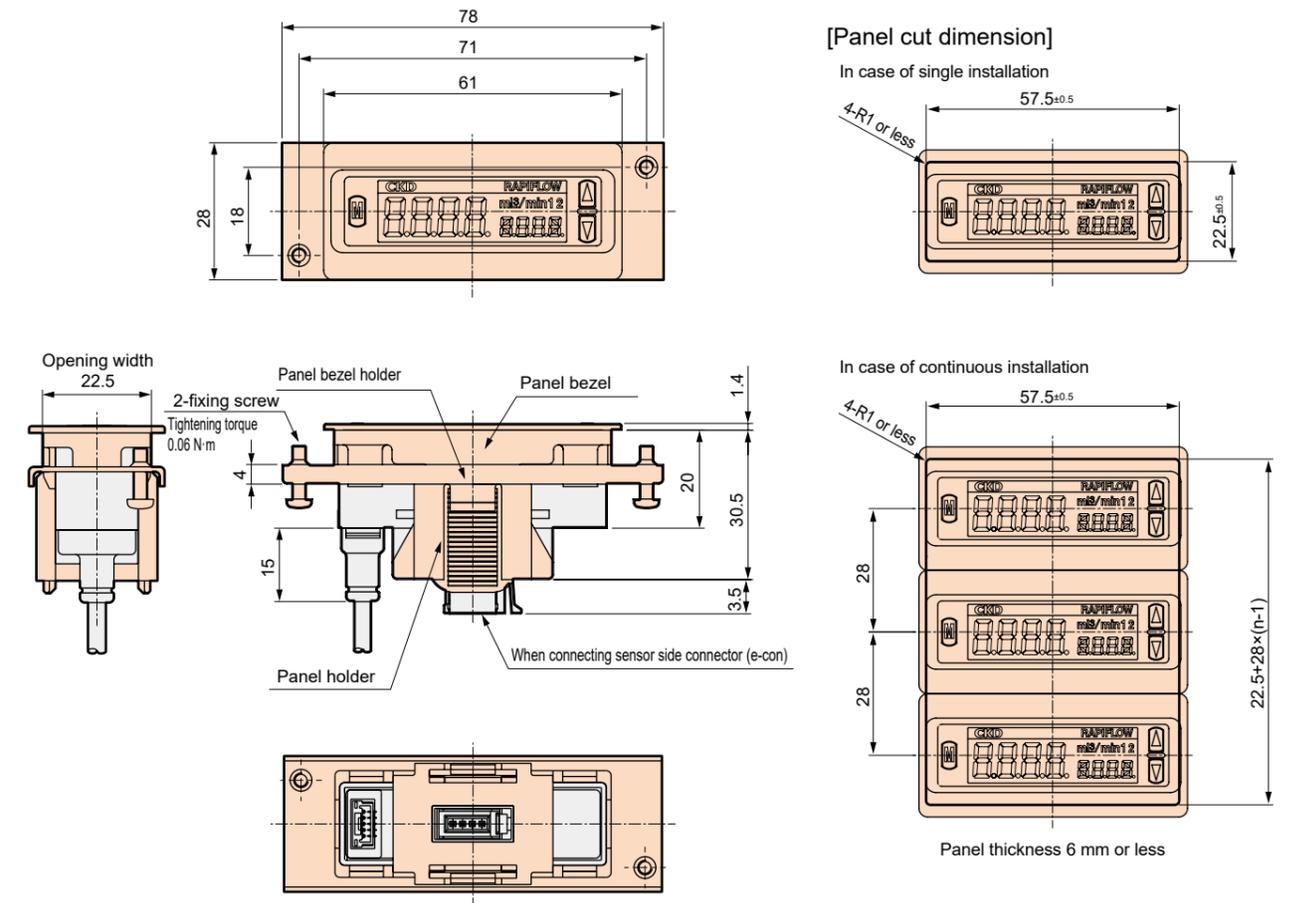
Dimensions

●FSM2-D-□



Optional dimensions

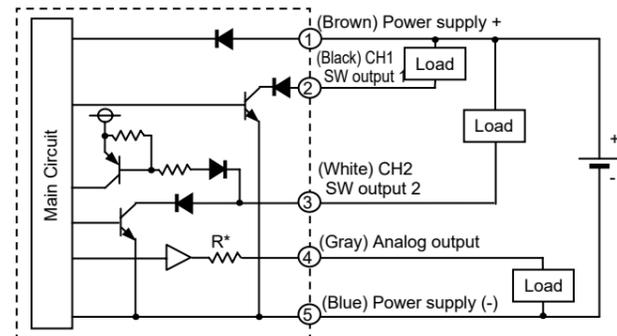
●Panel mounting kit with options Dimensions diagram



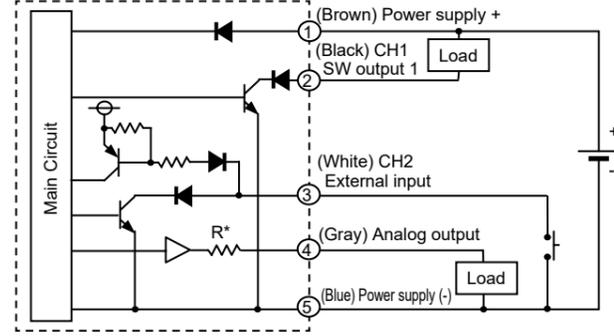
Example of internal circuit and load connection

●FSM2-D-N□□□ (separated display NPN output)

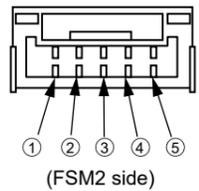
[CH2 is used as SW output]



[CH2 is used as external input]



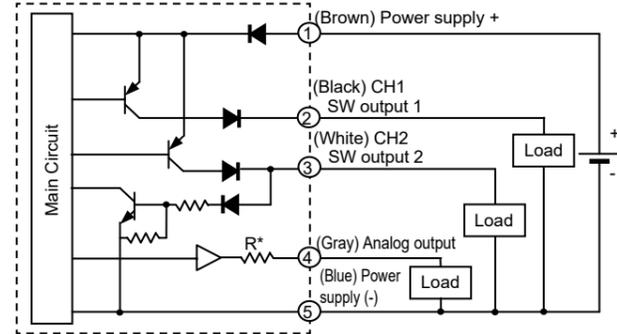
*Analog output Voltage output R: approx. 1 kΩ
Current output R: approx. 100 Ω



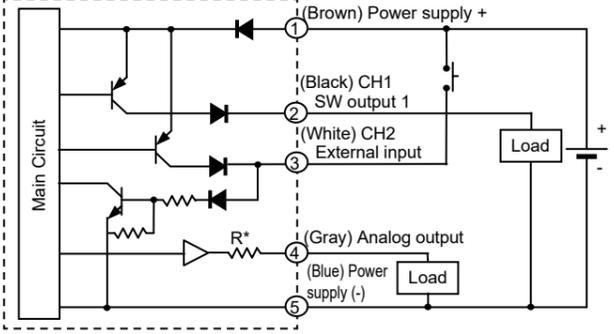
Terminal No.	Option cable color	Name
①	Brown	Power supply (+) (voltage output: 12 to 24 V, current output: 24 V)
②	Black	CH1 (switch output 1: max 50 mA)
③	White	CH2 (switch output 2: max. 50 mA or external input)
④	Gray	Analog output voltage output: 1-5 V load impedance 50 kΩ or more Current output: 4-20 mA load impedance 300 Ω or less
⑤	Blue	Power supply - (GND)

●FSM2-D-P□□□ (separated display PNP output)

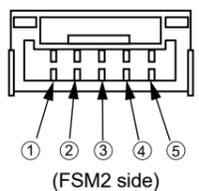
[CH2 is used as SW output]



[CH2 is used as external input]



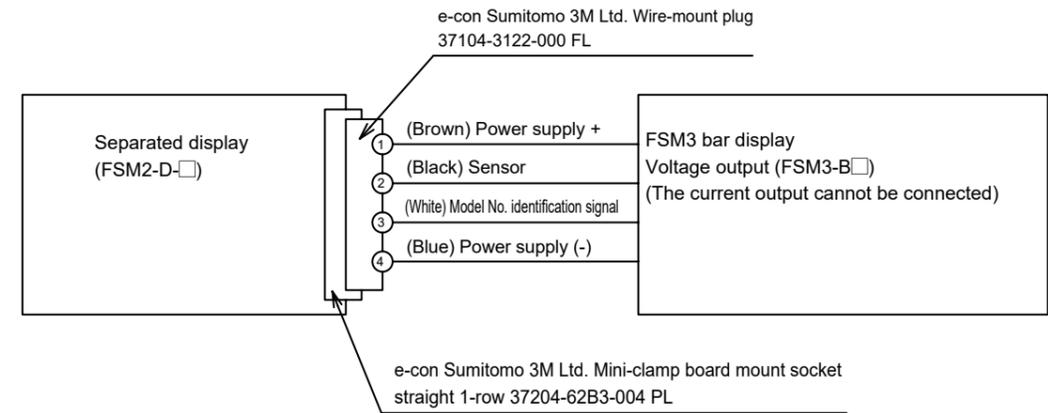
*Analog output Voltage output R: approx. 1 kΩ
Current output R: approx. 100 Ω



Terminal No.	Option cable color	Name
①	Brown	Power supply (+) (voltage output: 12 to 24 V, current output: 24 V)
②	Black	CH1 (switch output 1: max 50 mA)
③	White	CH2 (switch output 2: max. 50 mA or external input)
④	Gray	Analog output voltage output: 1-5 V load impedance 50 kΩ or more Current output: 4-20 mA load impedance 300 Ω or less
⑤	Blue	Power supply - (GND)

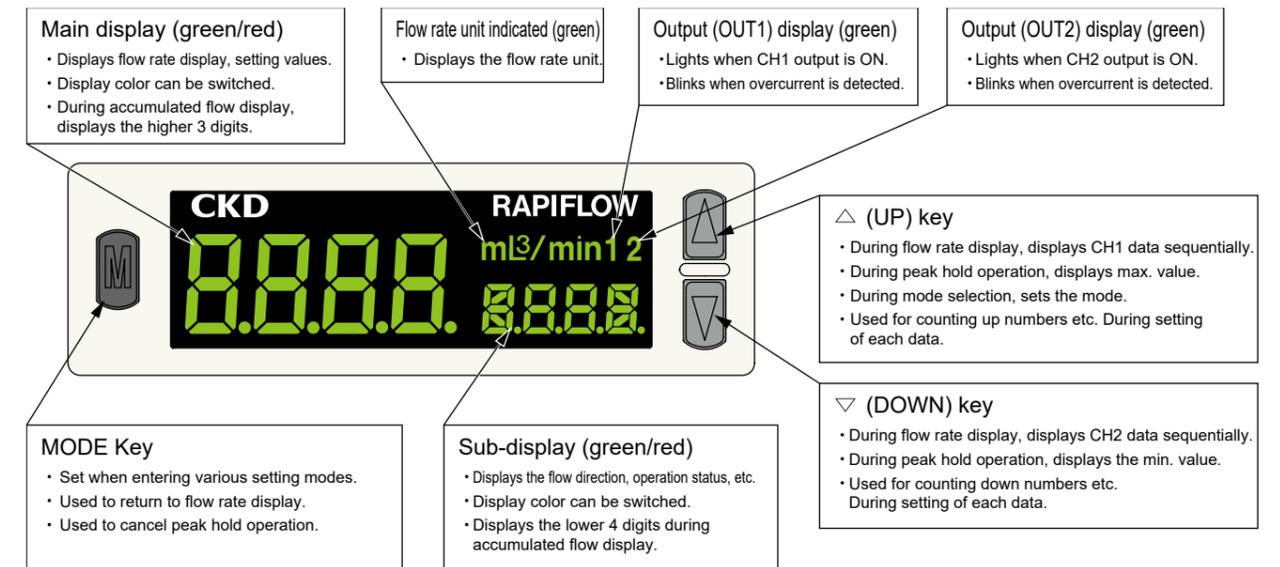
Example of internal circuit and load connection

● Connecting the separate display and the FSM3 bar display



When connecting to the FSM-V Series or WFK Series, the cable size is different so a separate compatible sensor connector (e-con) will be required.

Names and functions of display / operation section



Description of functions

The function and various settings may be performed during normal flow rate display or after entering each mode. The setting mode is divided into the standard setting mode and detailed setting mode according to the frequency of use.

Normal operation

Item	Explanation	Default setting
Instantaneous flow rate display	Indicates the instantaneous flow rate.	-
Accumulated flow display	The accumulated flow can be displayed. The switch output function includes a function to turn the switch ON/OFF at a level higher than the recommended cumulative value, and an integrated pulse function to output the pulse at a set cumulative value. Reset when powered OFF. Can also be reset with button operations or external inputs.	Instantaneous flow rate display
Peak hold function	Max. and min. values for the flow rate within a set interval are displayed.	Peak hold OFF
Key lock function	The key operations can be locked to prevent inadvertent operations.	Key operation possible
Error display function	The error status is displayed when a fault or error occurs.	-

Standard setting mode

Item	Explanation	Default setting
Switch output function	This product has 2-point switch output, and uses seven operation patterns and a stop operation.	Switch is set to OFF for both CH1 and CH2
Forced output function	Forces the switch output to turn ON and is used to check the initial operation of wiring connections and input devices.	-
Zero adjustment	The zero point deviation is compensated. (Range: 0±10%F.S.)	Adjust value: 0

Detailed setting mode

Item	Explanation	Default setting
Selection of flow rate direction	Setting the flow direction. Setting available for bi-directional, one-sided forward direction or one-sided reverse direction.	Bi-directional setting
Selection of CH2 operation	Select the CH2 feature. Select whether to use CH2 as a switch output, or to use as an external input (integrated value reset/auto reference).	Switch Output
Auto reference function	When CH2 is selected as auto reference, the switch's output threshold can be imported with external inputs or button operations. The threshold can be changed automatically if the switch threshold value changes, such as when the workpiece is changed.	Auto reference function OFF
Response time setting	Set the response time. The response can be set in seven steps from 50 ms to approx. 1.5 s. Chattering and mis-operation caused by sudden flow rate changes or noise are prevented.	Response time: 50 ms
Indicator speed setting	The digital display refresh cycle can be set in three stages from 250 ms to 1 s. If the display flickers, it can be improved by increasing the display refresh cycle.	Display speed: 250 ms
Sub-display setting	Sets the display method for the sub-display. The display can be changed to flow direction, flow rate unit or gas type display.	Flow direction display
Setting of display color	Set the display color. Display color can be set for normal display and when switch output is ON.	When normally displayed for both main and sub: Green At switch ON: Red
Setting hysteresis	Set the switch setting value hysteresis. Use this if the flow rate pulsates or if the switch chatters near the threshold, etc.	Hysteresis: 1%FS
Setting flow rate unit	Select the display unit from the standard state or reference state. Standard condition (ANR): Converted into volumetric flow rate at 20°C, 1 barometric pressure Reference state (NOR): Converted into volumetric flow rate at 0°C, 1 barometric pressure (*1)	Flow rate unit: ANR
Setting ECO MODE	An ECO mode can be set. If the buttons are not operated for approx. 1 minute, the eco mode will activate and turn OFF the display's backlight. Current consumption can be reduced with this mode.	ECO MODE OFF
Reset setting	It will return to the factory settings. For the separated indicator, if the power is switched ON again with the FSM2 separated display (sensor unit) connected after setting reset, the flow range is automatically recognized.	-
Model selection	Select the flow rate range, flow direction and gas type.	Not set (*2)

*1: The reference state display is a calculated (reference) value.

*2: The default setting is "Not set". If "Not set" is selected during use, the operation will start from the model selection mode after the power is turned ON. Always set the model before starting use. The model is automatically recognized in the "Not set" state (default state) only when the FSM3 bar display (sensor) is connected.

Switch output functions

The output function can be selected from seven types of switch operations according to the required application. The functions are compatible with both CH1 and CH2.

Name of operation pattern	Explanation	Operation waveform	LCD display
Window operation① (ON when inside the range)	The switch turns ON when the level is within the designated flow rate range.		Sub-display section
Window operation② (ON when outside the range)	The switch turns ON when the level is not within the designated flow rate range.		
Hysteresis operation① (ON at low flow rate side)	The hysteresis is randomly set, and the switch output turns OFF at the designated flow rate and higher.		
Hysteresis operation② (ON at high flow rate side)	The hysteresis is randomly set, and the switch output turns ON at the designated flow rate and higher. (The output is held even during the Hi display.)		
Cumulative value output① (ON at accumulated flow or higher)	Switch output turns ON at set cumulative value and higher.		
Cumulative value output② (OFF at accumulated flow or higher)	Switch output turns OFF at set cumulative value and higher.		
Integrated pulse output	The integrated pulse is output at the preset cumulative value. Refer to the "Integrating function" in the specifications for details on the preset integration value. (Page 357)		
Switch operation OFF	The switch operation is turned OFF.		

Flow rate sensor

Compact flow sensor (gas)
Compact flow sensor (air)
Compact flow sensor (liquid)

Water Manifold Unit

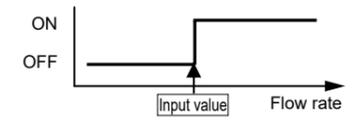
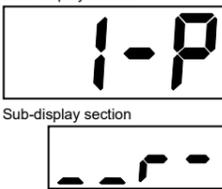
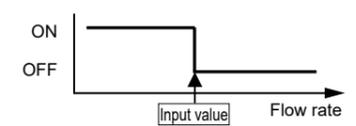
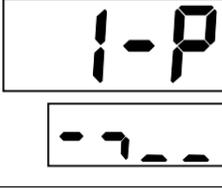
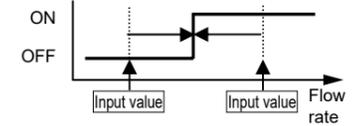
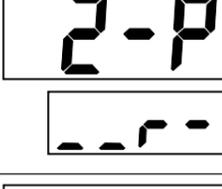
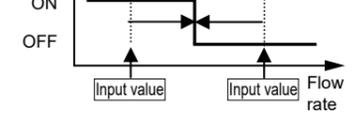
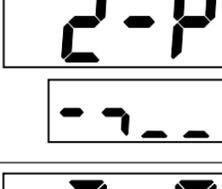
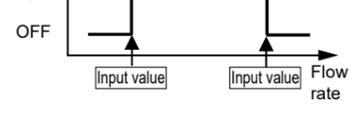
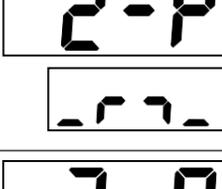
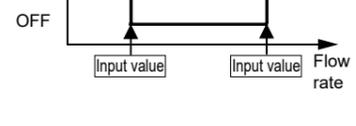
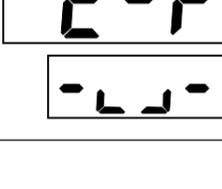
Flow rate sensor

Compact flow sensor (gas)
Compact flow sensor (air)
Compact flow sensor (liquid)

Water Manifold Unit

Automatic reference function

When CH2 is selected as auto reference, the switch's output threshold can be imported with external inputs or button operations. The threshold can be changed automatically if the switch threshold value changes, such as when the workpiece is changed. The flow rate value at the point where the external input is turned ON is read for the input value. The CH2 switch settings are invalid during auto referencing.

No. of inputs	Name of operation pattern	Explanation	Operation waveform	LCD display
1 points	ON at input value or higher	ON when higher than imported value. (Threshold : input value)		Main display section 
	OFF at input value or higher	OFF when higher than imported value. (Threshold : input value)		Main display section 
2 points	ON when higher than middle value of two points.	ON when higher than middle value of two imported points. (Threshold: (input①+ Input②) / 2)		Main display section 
	OFF when higher than middle value of two points.	OFF when higher than middle value of two imported points. (Threshold: (input①+ Input②) / 2)		Main display section 
	ON between 2 points	ON when between two imported points. (Threshold①: Input value①) (Threshold②: Input value②)		Main display section 
	OFF between 2 points	OFF when between two imported points. (Threshold①: Input value①) (Threshold②: Input value②)		Main display section 

MEMO

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit



Pneumatic components (sensors) Safety Precautions

Be sure to read this section before use.
For general pneumatic components precautions, refer to Intro 17 for details.

Product-specific cautions: Compact flow rate sensor separated display FSM2-D Series

Design / Selection

Working environment

⚠ DANGER

■ Flammable environment

Never use this product in an explosive gas atmosphere. The structure is not explosion-proof, and explosions or fires could occur.

⚠ WARNING

■ Corrosive environment

Do not use this product in an atmosphere containing corrosive gases such as sulfur dioxide.

■ Ambient temperature

Use at ambient temperatures within the specified range of 0 to 50°C. Even if the temperature is within the specified range, do not use this product if the ambient temperature could suddenly change and cause dew to condense.

■ Drip-proof environment

The degree of protection of this product is equivalent to IP40. Do not install this product where water, salt, dust, or swarf is present or in a pressurized or depressurized environment. The product cannot be used with large temperature variations or high temperature/humidity since condensation may occur inside the body.

Mounting

⚠ CAUTION

■ The LCD display-type flow rate meter uses a liquid crystal display. This may be difficult to read depending on the angle.

■ Do not install multiple product bodies in close contact. The generation of heat on each part could cause the product's temperature to rise, hastening changes in characteristics or deterioration of the resin material. When using the products in a row, set intervals of distance of 10 mm and over.

Wiring

⚠ WARNING

■ Use a DC stabilized power supply within the specified rating, insulated from the AC power supply. A non-isolated power supply could result in electrical shock. If power is not stabilized, the peak value could be exceeded. This could damage the product or impair accuracy.

■ Always attach the connector bar after connecting the connector.

■ Check that stress (7 N and over) is not directly applied to cable leadouts or connectors.

■ Connecting load

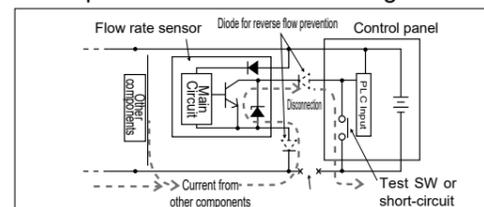
The output impedance of the analog output section is approx. 1 kΩ. If the impedance of the connecting load is small, output error increases. Check error with the impedance of the connecting load before using. (The analog/current output type is excluded.)

Example of calculation

$$\begin{aligned} & \text{(FSM2-□V output impedance: } R_o = 1 \text{ k}\Omega \\ & \text{Load internal impedance: } R_x = 1 \text{ M}\Omega \\ & \text{Output value} = \left(1 - \frac{R_o}{R_o + R_x}\right) \times 100\% \\ & = \left(1 - \frac{1 \text{ k}\Omega}{1 \text{ k}\Omega + 1 \text{ M}\Omega}\right) \times 100\% \Rightarrow \text{Output value error approx. } 0.1\% \end{aligned}$$

⚠ CAUTION

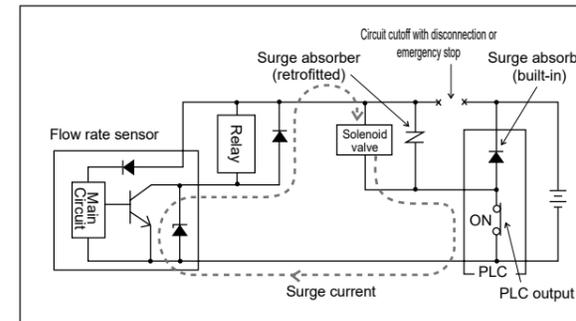
■ Pay attention to reverse currents caused by disconnected wires and wiring resistance. If other devices, including a flow rate sensor, are connected to the same power supply as the flow rate sensor, and the switch output wire and power cable negative (-) side are short-circuited to check the operation of the control panel input unit, or if the power cable negative (-) side is disconnected, reverse current could flow to the flow rate sensor's switch output circuit and cause damage.



■ Take the following measures to prevent damage caused by reverse current:

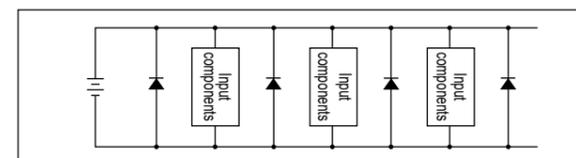
- ① Avoid centralizing current at the power cable, especially the minus side power cable, and use as thick a cable as possible.
- ② Limit the number of devices connected to the same power source as the flow rate sensor.
- ③ Insert a diode parallel to the flow rate sensor's output line to prevent reverse current.
- ④ Insert a diode parallel to the flow rate sensor power wire's negative (-) side to prevent reverse current.

■ Pay attention to surge current flow-around. When flow rate sensor power is shared with an inductive load that generates surges, such as a solenoid valve or relay, if the circuit is cut off while the inductive load is functioning, surge current could enter the switch output circuit and cause damage depending on where the surge absorber is installed.



Take the measures below to prevent damage from sneak surge current.

- ① Separate the power supply for output including the inductive load, such as the solenoid valve and relay, and input, such as the flow rate sensor.
- ② If a separate power supply cannot be used, directly install a surge absorption element for all inductive loads. Consider that the surge absorber connected to the PLC, etc., protects only the individual device.
- ③ In addition, connect surge absorbing elements at various locations in the power supply wiring as shown in the figure below to prepare for disconnection at unspecified locations.



When the devices are connected to a connector, the output circuit could be damaged by the above phenomenon if the connector is disconnected while the power is ON. Turn power OFF before connecting or disconnecting the connector.

For precautions during mounting, installation, adjustment, use and maintenance, refer to the CKD Components Product Site (<https://www.ckd.co.jp/kiki/en/>) → "Model No. → Instruction Manual"

Other

⚠ WARNING

■ Output accuracy is affected by temperature characteristics and heat generated when energized. Provide a standby time (5 minutes or more) after turning the power ON for use.

■ Immediately after power is turned ON, flow rate detection switch operation is not performed for approx. 4 seconds to complete self-diagnosis. Provide a control circuit/program that ignores signals for at least two seconds after power is turned ON.

⚠ CAUTION

■ Analog output continues even if the flow rate range is exceeded. Hi or "Lo" will be displayed. Note that this is outside the guaranteed precision.

■ CE-compliance working conditions

This product is CE-marked, indicating conformity with the EMC Directives. The standard for the immunity for industrial environments applied to this product is EN61000-6-2; the following requirements must be satisfied in order to conform to this standard:

- Conditions
- The evaluation of this product is performed by using a cable that has a power supply line and a signal line paired to assess the product's performance.
 - This product is not equipped with surge protection. Implement surge protection measures on the system side.

■ The corresponding sensor is the voltage output (1-5 V) type. If the current output-type or other voltage output-type is connected, it will not operate properly.

■ It does not have the function to detect signal interruption due to cable disconnection or the state of connection with the sensor. If detection is required, the customer must prepare it separately.

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Ending

Flow rate sensor

Compact flow sensor (gas)

Compact flow sensor (air)

Compact flow sensor (liquid)

Water Manifold Unit

Ending